Industrial Outreach at the National Center for Microgravity Research

Creating a bridge between research and industrial technologies and commercial applications

The National Center for Microgravity Research (NCMR) is a collaborative effort between Case Western Reserve University (CWRU) and the Universities Space Research Association (USRA) through which the staff scientists support NASA's exploration mission and conduct independent research.

The bridge symbolizes a link between research and its application to systems, processes, and products. The scientists at the NCMR can collaborate via contracts, grants, cooperative agreements, and even purchase orders. Each of these instruments can be covered by a nondisclosure agreement, as represented by the covered bridge.

The rubric under which the NCMR operates, for both NASA and in external partnering, is through a research-for-design (R4D) process, pioneered by Dr. Simon Ostrach, NCMR's director. Within this concept, directed research solves practical problems and develops solutions for new technologies.

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	NCMR Expertise and Knowledge	Industrial Applications and Systems
Fluids and Transport	Thermophysical property measurements of fluids	Fluid surface and interfacial tension, viscosity density, and their thermal dependencies
	Interfacial heat and mass transport, phase change, and two-phase flow	Heat exchangers and HVAC and refrigeration systems
	Capillarity and contact angles	Microfluidics and two-phase flow in porous media
	Wetting and spreading of simple and complex (non-Newtonian) fluids	Printing, spray and spin coating, and film drying
	Chemical processing technology	Processing of advanced alloys and novel materials and application of paints and coatings
Reaction-BasedProcesses	Soot formation processes	Engines, furnaces, and emission control
	Swirl and turbulent combustion	Engine combustion, burner flame stabilization, and compact burners
	Electric field interaction with flames	Pollutant (emission) control
	Fuel-modulated burners	Compact furnaces and boilers
	Fire suppression	Fire extinguishers and containment
	Partially premixed flames	Waste incineration, NOx reduction strategies, and liquid fuel flash points
	Soot and carbon oxidation	Char burn out in coal-fired power plants and engine and combustor particulate exhaust control
	Flame spread processes	Fires in industrial cookers, fuel/solvent spills, ocean oil spills, and mine fires
	Scaling effects in combustion and catalytic processes	Microcombustors and portable power sources
Bio-engineering	Bone structure, growth, and mechanics	Osteoporosis, healing, and prosthetics
	Modeling coupled transport and reaction phenomena in biological systems	Bioreactor design, operation, and modeling
	Fluid dynamics of the heart, vestibular system, and pulmonary system	Human health in variable g-environments, medical devices, and clinical trial development
Nano-technology	Electron microscopies (Scanning electron microscopy and high-resolution transmission electron microscopy)	Material (crystal) structure, composition, and interfacial characterization
	Nanomaterials of carbon (nanotubes), metal oxide semiconductors, and quantum dots	Reinforcing materials, catalyst support media, gas storage material, battery electrodes, sensors, fuel cells, and cellular probes
Optical Diagnostics	Laser-induced fluorescence (LIF)	Measurement of biological processes, biological detection, species, and temperature
	Particle-image velocimetry (PIV)	Velocity measurements in reacting and nonreacting flows, microfluidics, and microreactors
	Multiwavelength and SiC filament pyrometry	Measurement of surface and/or gas temperatures
	Common-path interferometry	Determination of thermal and mass diffusion, thin film thickness, and surface profilometry
	Infrared thermography	Reaction and thermal process control, nondestructive testing, and medical imaging
	Schlieren	Temperature and concentration gradients
	Laser-induced incandescence (LII)	Soot concentration and particle size
Computational Modeling	Finite volume and finite elements	Boilers, furnaces, and propulsion devices
	Front tracking methods	Fire simulation (such as in Combustion Integrated Rack and International Space Station)
	Fluid structural interactions	Laminar reacting flows
	Front capturing methods: Level set, VOF, and phase field Computational structural dynamic (CSD) Computational mesh dynamic (CMD) Computational fluid dynamic (CFD) Asymptotics and perturbation techniques	Coating processes and film formation and flows Power cycles and engines Materials and processing
	Commercial codes: Fluent, Fidap, STARCD, CFD-ACE, ADIN	Free surface flows, buoyancy, driven convection, rotating systems, electrochemical systems, microfluidics and microelectromechanical system devices, and flame spread across liquids and layered gases